Ownership matrix

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1.0 PURPOSE AND SCOPE

(5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5)

This standard establishes structural design loads and acceptance criteria for use in designing new Structures, Systems, and Components (SSC), evaluating existing SSCs, evaluating anchorage effects of new and modified systems on existing SSCs, and designing additions and modifications to existing SSCs. This standard fulfills three objectives:

- Integration of the Natural Phenomenon Hazards (NPH) requirements with DOE and other requirements governing design and evaluation of SSCs

- Limit requirements and NPH criteria to those applicable to the Tank Operations Contractor (TOC)

- Stipulate the appropriate levels of depth, rigor, and thoroughness in complying with the requirements.

This standard does not apply to “temporary structures” or small storage units (e.g., conex boxes). However, the safety aspects of the structure shall be considered (e.g., fire protection, occupant load, means of egress, etc.). Design and analysis requirements for all DOE Tank Operations Contractor facilities are provided.

2.0 IMPLEMENTATION

This standard is effective on the date shown in the header.

This standard applies to any building acquisition, new or existing facility design, facility addition and alteration, leased facilities (including on-site constructed buildings), pre-engineered buildings, plant-fabricated modular buildings, mobile offices, trailers, equipment, and temporary facilities.

3.0 STANDARD

3.1 General

The use of this information does not preclude the proper evaluation of other structural loads or stress-inducing phenomena such as stability, settlement, differential motions, and construction. If situations arise where criteria in this standard are inadequate, alternate criteria may be used with justification.

This document is intended for use by experienced engineers familiar with DOE orders and standards and national building codes and standards. In accordance with DOE 420.1B, Chapter IV, Section 3.a.2.c and EO 12699, the TOC has implemented TFC-ENG-STD-06 and has required the use of consensus codes and standards where appropriate. The users must be familiar with, and have a working knowledge of, the International Building Code (IBC), DOE-STD-1020-02, DOE-STD-1189-08, American Society of Civil Engineers (ASCE) 7, ASCE 43-05 and ANSI-ANS 2.26. The 2006 version of the IBC is in effect until July 1, 2010 when the 2009 IBC code becomes effective. The State of Washington WAC 51-50 makes the 2009 IBC effective on July 1, 2010. Users should also be familiar with and have a working knowledge of national codes and standards applicable to the design, materials, construction, and function of SSCs (e.g., American Concrete Institute (ACI) 318; American Iron and Steel Institute (AISI); American Association of State Highway and Transportation Officials (AASHTO)).

The DOE-STD-1189 provides the Department of Energy's expectations for incorporating safety into the design process for new or major modifications to DOE Hazard Category 1, 2, and 3 nuclear facilities, the intended purpose of which involves the handling of hazardous materials, both radiological and chemical, in a way that provides adequate protection for the public, workers, and the environment. The standard describes the Safety-in-Design philosophies to be used with the project management requirements of DOE O 413.3A, Change (Chg) 1, Program and Project Management for the Acquisition of Capital Assets, and incorporates the facility safety criteria in DOE O 420.1B, Facility Safety, as a key foundation for Safety-in-Design determinations. Initially this will be applied to all new projects and major modifications to SSCs.

3.2 General Design Criteria

(5.1.3.a, 5.1.3.b, 5.1.3.c)

SSCs shall be designed and evaluated to withstand loads associated with the operation of the facility and the effects of NPHs. Design and evaluation of SSCs shall comply with the loads and acceptance criteria given in this standard. In accordance with DOE O 420.1B, Chapter IV, Section 3.c.4, which requires "An NPH assessment review must be conducted at least every 10 years." CH2M HILL letter number CH2M-0501112 released on 5/16/05 provides an evaluation of the potential impacts of the revised seismic spectra which was incorporated in revision C-1 of this standard. Therefore, the next seismic review is due in May 2015. This task is tracked in ESTARS as WRPS-CENTRALDESIGN-2009-0002. In accordance with DOE 420.1B, Chapter IV, Section 3.b.1 and EO 12941, which require "SSCs in existing DOE facilities must be evaluated." RPP-8728, "Prioritization of Natural Phenomena Hazard Evaluations for CHG Facilities" has been issued. It is the intent of this document to conform to and/or use national consensus codes and standards when appropriate. The IBC and ASCE 7 shall be used as the minimum basic design requirements for DOE facilities. Implementation of DOE-STD-1189 for new projects and major modifications will require the application of ANSI-ANS 2.26 for the definition of the safety function of the SSCs and utilize that classification to determine the design criteria in accordance with ASCE 43-05.

3.3 Safety and Performance Category Correlation

(5.1.3.a, 5.1.3.c, 5.1.3.d)

For design purposes and the application of these criteria, the design loads and acceptance criteria for SSCs shall be correlated to performance category designation. The correlation of safety classification and performance categories are shown in Table 1, the development of which is contained in HNF-SD-GN-ER-30037. Performance category designation should be evaluated and may be upgraded to provide additional conservatism, as described in DOE-G-420.1-2.

Existing buildings and structures that are designated PC-0 do not require NPH qualification or mitigation. This categorization allows reduced design requirements. In order to be designated PC-0, buildings and structures must meet the requirements of DOE-STD-1021-93.

The design of in-tank equipment that is not required to function during or after an earthquake and is not safety related (PC-1 or PC-1M) is not required to be analyzed for the effects of tank sloshing. In all cases, the failure of a lower safety class SSC shall be shown to not damage higher safety class SSCs. The basis for this interpretation, the IBC and ASCE 7, are life safety codes and the discussion of sloshing in these codes is directed at the tank design requirements.

In-tank equipment that has no safety implication does not require the rigorous sloshing calculations. The requirement to evaluate PC-1 over PC-2 has always been a requirement and is not changed.

Temporary structures and uses shall conform to the structural strength, fire safety, means of egress, accessibility, light, ventilation, and sanitary requirements to ensure safety.

An assessment of the interaction effects between different PCs should be performed. The effects of lower PC SSC on the performance of the higher PC SSC should be evaluated. If any behavior of the lower PC SSC has any adverse effect on the performance of the higher PC SSC, it should be documented and appropriate evaluation action should be taken. For further discussion on this issue, see DOE-STD-1021-93.

3.3.1 Design Criteria Implementation

(5.1.3.a, 5.1.3.d)

Figure 1 shows the process for determining design criteria. It should be used for existing systems in conjunction with the Documented Safety Analysis (DSA) to determine the tank farm component performance criteria, and therefore, the design criteria. Documented design requirements are not necessarily available for many existing SSCs. Therefore, for existing safety SSCs functioning during or subsequent to natural phenomena events, at least PC-1 natural phenomena design loads should be used for existing tank farm components, unless the criteria from Section 3.3 can be demonstrated to justify a PC-0 classification.

For major modifications or new structures, SSC NPH design criteria should be based on safety analyses specific to the modification or new structure using the guidelines in Table 1. All SSCs shall maintain their safety function, as identified by the safety analysis and the safety equipment list, under these design loads.

3.4 Anchorage of Equipment

Anchorage for PC-1 and PC-2 systems and components using expansion anchors shall follow Table 2 requirements and may use industry standard anchor having capacities published by the International Code Council (ICC). For vibratory equipment and dynamic loading undercut anchors are preferred, however, adhesive anchors are acceptable for smaller loads. The ICC evaluation reports provide allowable shear and tension values for installation, both with and without special inspection. Unless otherwise specified in the design documentation, the values without special inspection shall be used. In compliance with DOE-STD-1020-02, anchor bolts of a minimum (12 mm) ½ inch in diameter are recommended regardless of calculated anchorage requirements.

All post installed anchor bolts shall be designed and installed in accordance with the ICC standards. For fall protection anchors and hoisting and rigging applications, undercut anchors shall be used. Undercut anchors shall be used for all overhead applications.

Analysis, testing, or the use of seismic experience data may determine seismic adequacy. Seismic adequacy determined through the use of seismic experience data is likely to be more economical. Use of experience-based methods requires that adequate engineering analysis be performed by qualified, trained personnel to determine similitude of the equipment items to those available in the experience database.

Anchorage of equipment used for single-shell tank retrieval and closure and for facility deactivation must meet PC-1M requirements in accordance with RPP-16643. Table 2 provides further details.

Anchorage of existing systems and components using concrete expansion anchors, cast-in-place bolts (j-bolts, headed studs, etc.), and grouted-in-place bolts shall use allowable bolt capacities from HNF-SD-GN-DGS-30006.

3.5 Design Loads

Design loads are applied, depending on the safety classification and performance category of the SSCs considering:

- Dead loads
- Live loads
- Snow loads
- Wind loads
- Earthquake loads
- Volcanic ashfall loads
- Flood loads
- Earth and groundwater pressure loads
- Thermal loads
- Concrete creep and shrinkage loads.

Use TFC-ENG-STD-02 for environmental/seasonal conditions.

3.5.1 Dead Loads

Dead loads include the weights of all permanent materials and equipment, including the structures own weight. Design dead loads shall include the weight of all permanent service equipment. Service equipment shall include plumbing stacks, piping, heating and air conditioning equipment, electrical equipment, fire sprinkler piping and valves, and similar fixed furnishings. Load calculations shall include an allowance for any loadings anticipated to be added at a later date. The final design loads must reflect the field configuration as shown on the drawings.

Unless other source references are provided, the IBC and ASCE 7 shall be used to determine unit weights. Where unit weights are neither established in the IBC or ASCE 7 nor determined by test or analysis, the weights shall be determined from data in manufacturer drawings or catalogs. The unit weights of materials for highway structures shall be those given by AASHTO standards.

3.5.2 Live Loads

Live loads are those loads produced by the use and occupancy of the building or other structure and do not include construction and environmental loads such as wind load, snow load, rain load, earthquake load, flood load, or dead load. Live loads on a roof are produced by maintenance workers and equipment and within a structure by partitions, people, and office equipment.

- Live loads for buildings and other structures shall be not less than the minimum uniform load or concentrated load.
- The minimum roof design live load shall be 20 lb/ft^2.
- The weight of service equipment that may be removed with change of occupancy of a given area shall be considered as live load.
- Live loads for highway structures shall also comply with AASHTO HB-16. Unless specified otherwise, an HS 20-44 loading shall be used.

3.5.3 Snow Loads

Snow loads, full or unbalanced, shall be substituted for roof live loads in Section 3.6.2 where such loading results in larger members or connections. A ground snow load, P_g, of 15 lbf/ft^2 shall be used for calculating roof snow load. Unbalanced snow loads resulting from drifting or sliding shall be considered.

3.5.4 Wind Loads

Wind load design for buildings and other structures shall use the “Three-Second Gust Wind Velocity” obtained from Table 3. The structural frame and exterior components of all buildings, signs, tanks, towers, and other exposed structures including movable equipment shall be designed to resist pressures from wind from any direction. Partial wind loading shall be considered if it produces a more severe effect. Design basis tornadoes are not applicable to PC-1 and PC-2 SSCs on the Hanford site (see HNF-SD-GN-ER-501 and TFC-ENG-STD-02).

3.5.5 Earthquake Loads

(5.1.3.e)

3.5.5.1 PC-1 and PC-2 Structures, Systems, and Components

Earthquake load design of PC-1 SSCs shall comply with the IBC Seismic Use Group I requirements. Earthquake load design of PC-1M equipment is not required. (See Table 2 for PC-1M requirements.) PC-1M applies to temporary equipment used for SST retrieval/closure and for facility deactivation. Earthquake load design of PC-2 SSCs shall comply with the IBC Seismic Use Group III requirements (importance factor = 1.5).

3.5.5.2 Response Spectra

Response spectra values from RPP-RPT-27570 shall be used. The horizontal $S_{D1} = .192$ and $S_{DS} = .588$ and the vertical $S_{D1} = .098$ and $S_{DS} = .346$. IBC site class C shall be used as described in RPP-RPT-27570 for all tank farms. The Hanford Site general soil profile supports the use of site class C; however, for any new PC-2 facilities outside the tank farms the site class shall be verified.

3.5.5.3 PC-3 and PC-4 Structures, Systems, and Components

There are no PC-3 or PC-4 SSC Tank Operations Contractor facilities. PC-3 seismic design values will be developed if required for future SSCs.

3.5.6 Ashfall Loads

Design ashfall loading is 3 lb/ft^2 for PC-1 and 5 lb/ft^2 for PC-2. Ashfall in combination with roof live loads will normally produce the highest loading for design. (See HNF-SD-GN-ER-30038 and HNF-SD-GN-ER-501). The use of 20 lb/ft^2 minimum live load accounts for ashfall loads.

3.5.7 Flood Loads

The 200 Area is approximately 200 ft above the Columbia River at its nearest flood inundation point. These areas are dry sites and need not consider Columbia River flooding in design for any performance category.

3.5.8 Earth and Groundwater Pressures

Every foundation wall or other wall serving as a retaining structure shall be designed to resist (in addition to the vertical loads acting on it) the incident lateral earth pressures and surcharges, plus hydrostatic pressures corresponding to the maximum probable groundwater level.

Soil properties for PC-2 structures shall be determined from subsurface investigations (see Section 3.9). A minimum soil density of 110 lbf/ft^3 should be used for PC-1 structures and may be used for PC-2 structures until the subsurface soil investigations are completed.

For PC-1 structures, the allowable soil bearing pressure from the IBC may be used for design where precise soil-bearing information is not available. These values are considered to be acceptable for undisturbed earth.

Lateral earth pressures for PC-1 and PC-2 structures shall be as follows, unless site-specific soil conditions have been determined from subsurface investigations. Site-specific soil conditions shall be used, when known.

- Cantilever or other flexible walls exposed to earth fill shall be designed for a static equivalent fluid pressure of 30 lbf/ft^2, based on an active earth pressure coefficient, K_a, of 0.27 and soil density of 110 lbf/ft^3.

- Basement or other rigid walls exposed to ordinary compacted backfill shall be designed for a static equivalent fluid pressure of 55 lbf/ft^2, based on an at-rest earth pressure coefficient, K_o, of 0.50 and a soil density of 110 lbf/ft^3.

- Rigid walls exposed to backfill compacted to at least 75% of relative density shall be designed for 77 lbf/ft^2, based on a K_o of 0.70 and a soil density of 110 lbf/ft^3.

- Superimposed lateral pressures resulting from uniform surcharge loadings shall be calculated by using appropriate earth pressure coefficients as shown above. Resultant forces from point and line loads shall be added.

3.5.9 Thermal Forces

The design of structures shall include the effects of stresses and movements resulting from variations in temperature. Structures shall be designed for movements resulting from the maximum seasonal temperature change (-25°F to +115°F). The design shall provide for the lags between air temperatures and the interior temperatures of massive concrete members or structures. Consideration shall be given to passive soil loading resulting from thermal growth of sub grade structures. Use TFC-ENG-STD-02 for environmental/seasonal conditions.

3.5.10 Creep and Shrinkage Forces

Concrete and masonry structures shall be investigated for stresses and deformations induced by creep and shrinkage. For concrete and masonry structures, the minimum linear coefficient of shrinkage shall be assumed to be 0.005 in/in., unless a detailed analysis is undertaken. The theoretical shrinkage displacement shall be computed as the product of the linear coefficient and the length of the member.

3.5.11 Load Factors and Load Combinations

Load combinations, allowable stresses, and strength requirements for load conditions for all SSCs, shall comply with the IBC and ASCE 7. See TFC-ENG-STD-07 for ventilation system requirements. Combination of loads and design requirements for highway structures shall be as stipulated in AASHTO HB-16.

3.6 Design Acceptance Criteria

At a minimum, design criteria shall comply with the IBC and ASCE 7. In all cases, the manufacturer's recommendations shall be followed. The following provides additional acceptance criteria:

3.6.1 Ceiling Suspension Systems

Suspended ceilings shall be earthquake resistant. They shall meet the requirements of ASTM E580 and ICC ER-4071.

3.6.2 Chimneys and Stacks

Design of reinforced concrete chimneys and stacks shall comply with ACI 307, unless otherwise justified in the design documentation. Masonry chimney design shall comply with ACI 530. Steel stacks and chimney design shall comply with ASME STS-1.

3.6.3 Concrete Sanitary Structures

Design of sanitary engineering concrete structures shall consider ACI 350.

3.6.4 Fuel Storage Tanks

In addition, steel fuel storage tanks shall comply with API 650. Fiberglass tanks shall comply with ASTM D4021 and UL-1316.

3.6.5 Highway Structures

Highway structures shall comply with AASHTO HB-16.

3.6.6 Light Gauge Steel

Light gauge steel shall comply with AISI Specifications for the Design of Cold-Formed Steel Structural Members (AISI SG-971 and SG-2000).

3.6.7 Masonry

The following sources may also be used as guides for the design of masonry structures:

- ACI 530
- ACI 530.1
- The Brick Industry Association (BIA) “Technical Notes on Brick Construction.”

3.6.8 Metal Fastening

Highway structures metal fastening shall use the requirements of AASHTO LTS-4.

Welding of structures shall comply with American Welding Society (AWS) standards such as AWS D1.1, D1.2, D1.3, D1.4, D1.6. Personnel and procedures for welding steel shall have been qualified in accordance with AWS D1.1 before welding. Qualification in accordance with American Society of Mechanical Engineers (ASME) ASME Section IX may be substituted for these requirements.

3.6.9 Pre-Engineered Metal Buildings

Pre-engineered buildings shall comply with the “Metal Building Systems Manual.” Where the use of the design loadings would prevent procurement of pre-engineered metal buildings, consideration may be given to deviation from these loadings. Such consideration shall be based on review of the type of occupancy and functional requirements of the particular building and a determination as to whether such deviation could be justified and permissible.

3.6.10 Steel Cables

Steel cables shall comply with ASCE 19 as modified by FEMA 450, Section 8.5.

3.6.11 Steel Decks

Steel decks for floor and roof construction shall comply with SDI-Publ. 30 and SDI-Publ. DDM03.

3.6.12 Steel Joists

Steel joist floor and roof construction shall comply with the Steel Joist Institute Standard Specifications and Load Tables for Steel Joists and Joist Girders.

3.6.13 Steel Water Tanks, Standpipes, and Reservoirs

Steel water tanks, standpipes, and reservoirs shall comply with NFPA 22 and AWWA D100.

3.6.14 Towers and Poles

Transmission towers for electrical power lines shall comply with ASCE 52.

Antenna towers shall comply with EIA-222-F.

Transmission pole structures shall comply with ASCE Manual 72.

3.6.15 Ventilation Systems and Components

For Ventilations systems and components, see TFC-ENG-STD-07.

3.6.16 Mobile Offices

Manufactured homes (mobile offices) shall be designed and manufactured in accordance with this standard and WAC 296-150F, “Factory-built housing and Commercial Structures.” Mobile offices shall be installed per the manufacturer specifications. If manufacturer specifications are not available, then install per NFPA 225 “Model Manufactured Home Installation Standard.”

3.7 Foundations

The potential adverse effects of frost heave and movements resulting from expansive soils shall be considered in the design.

The bottom of foundations of permanent structures (except elevated tanks and stacks) shall be at least 24 in. below finished grade and shall bear on undisturbed earth or on properly compacted backfill that has bearing capacity sufficient to meet design requirements.

The bottom of foundations supporting elevated tanks and stacks shall be at least 4 ft below finished grade and shall bear on undisturbed earth or on properly compacted backfill that has bearing capacity sufficient to meet design requirements.

Grade beams shall comply with ACI 318.

The design of piers shall consider ACI 336.3R.

The design of pile foundations shall consider the IBC and ACI 543R.

The design of ribbed-mat slabs shall consider ACI 336.2R.

Heavy vibration producing equipment, such as high-pressure air compressors, chillers, fire pumps, and engine/generator sets, shall have separate, isolated foundations.

All shoring and underpinning shall comply with the safety requirements of WAC 296-155, Part N.

Tiebacks analysis of plastic yielding in strutted excavations, analysis of the stability of the bottom of excavations, and shoring for deep excavations shall comply with SH 300.

Remedial underpinning shall be performed where existing foundations are inadequate. Precautionary underpinning shall be performed where new construction adjacent to an existing structure requires deeper excavation.

3.8 Subsurface Investigations

For PC-1 structures, the allowable soil pressure from IBC based on information in HNF-SD-GN-ER-30009 may be used for design where precise soil bearing information is not available. A bibliography and brief summary of geotechnical studies performed at the Hanford site have been documented in HNF-SD-GN-ER-30009. RPP-RPT-27570 provides detailed soil classification and shear wave velocity for the tank farms.

Subsurface investigations shall be made for new PC-2 structures located outside the tank farms. Subsurface conditions shall be determined by means of bore holes or other methods that adequately disclose soil and groundwater conditions. Data and other information obtained from prior subsurface investigations shall be used, supplemented by additional investigations at the specific location as deemed necessary by the structural engineer.

Subsurface investigations shall be performed under the direction of a qualified soils engineer, licensed by the state to practice as such. Appropriate geological investigations shall be made to determine the contribution of the foundation (subsurface) to the earthquake loads imposed on the structure and shall include, but not be limited to, a recommendation of foundation type, determinations of allowable soil bearing design capacity, and the possible effects of seismic activity on the soil mass. A settlement analysis under differential design loads shall be performed where differential settlement may cause structural or architectural damage.

4.0 DEFINITIONS

<u>Anchorage</u>. A device or a collection of devices that provide structural support or restraint for systems and components to prevent falling, sliding, overturning, and excessive displacement.

<u>Design basis ashfall</u>. The volcanic ashfall chosen as the basis for the design of structures.

<u>Design basis earthquake</u>. The earthquake ground motion chosen as the basis for the design of structures.

<u>Design basis wind</u>. The wind velocity chosen as the basis for the design of structures.

<u>Facility</u>. One or more building(s) or structure(s), including systems and components, dedicated to a common function (includes operating and non-operating facilities and facilities slated for decontamination and decommissioning).

<u>Interaction</u>. The potential damage and failure of structures, systems, and components because of both direct natural phenomena hazard effects and response of adjacent structures, systems, and components.

Natural phenomena hazard. An act of nature (e.g., earthquake, wind, tornado, flood, precipitation, volcanic eruption, or lightning strike) that poses a threat or danger to workers, the public, or to the environment by potential damage to structures, systems, and components.

Response spectrum (spectra). Seismic input for the dynamic evaluation of structures, systems, and components. A response spectrum is the relationship between the natural frequency of vibration and the acceleration, velocity, or displacement response of a simple oscillator. It shows amplified response of flexible structures, systems, and components.

Structures, systems, and components. A structure is an element or a collection of elements to provide support or enclosure (e.g., a building, free-standing tank, basins, dikes, or stacks). A system is a collection of components assembled to perform a function (e.g., piping, cable trays, conduits, or HVAC). A component is an item of equipment (e.g., a pump, valve, or relay, or an element of a larger array such as a length of pipe, elbow, or reducer).

Temporary structures. Temporary is defined as a period of less than 180 days per International Building Code (IBC), Section 3103 requirements.

5.0 SOURCES

5.1 Requirements

1. 10 CFR 851, “Worker Safety and Health Program.”
2. DOE O 252.1, “Technical Standards Program.”
3. DOE O 420.1B, “Facility Safety.”
4. DOE-STD-1020-02, “Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities.”
5. International Building Code (IBC) 2006.
6. DOE STD-1189-08, “Integration of Safety into the Design Process”.
7. WAC 51-50, “State building code adoption and amendment of the 2006 edition of the international building code.”

5.2 References

1. AASHTO HB-16, “Standard Specifications for Highway Bridges.”
2. AASHTO LTS-4, “Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals.”
3. ACI 307, “Design and Construction of Reinforced Concrete Chimneys.”
4. ACI 318, “Building Code Requirements for Structural Concrete.”
5. ACI 336.2R, “Suggested Analysis and Design Procedures for Combined Footing and Mats.”

6. ACI 336.3R, "Design and Construction of Drilled Piers."

7. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures."

8. ACI 530, "Building Code Requirements for Masonry Structures."

9. ACI 530.1, "Specifications for Masonry Structures."

10. ACI 543R, "Design, Manufacture and Installation of Concrete Piles."

11. AISI SG-971, "Specifications for the Design of Cold-Formed Steel Structural Members."

12. AISI SG-2000, "Specifications for the Design of Cold-Formed Steel Structural Members."

13. ANSI-ANS 2.26-2004, "Categorization of Nuclear Facility Structures, Systems and Components for Seismic Design."

14. API 650, "Welded Steel Tanks for Oil Storage."

15. ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

16. ASCE 19, "Structural Applications of Steel Cables for Buildings."

17. ASCE 43-05, "Seismic Design Criteria for Structures, Systems and Components in Nuclear Facilities."

18. ASCE 52, "Guide for Design of Steel Transmission Towers."

19. ASCE Manual 72, "Design of Steel Transmission Pole Structures."

20. ASME Section IX, "ASME BPV Section IX Welding and Brazing Qualification"

21. ASME STS-1, "Steel Stacks."

22. ASTM D4021, "Glass Fiber Reinforced Polyester Underground Petroleum Storage Tanks."

23. ASTM E580, "Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and for Lay-in Panels in Areas Requiring Seismic Restraint."

24. AWS D1.1, "Structural Welding Code – Steel."

25. AWS D1.2, "Structure Welding Code – Aluminum."

26. AWS D1.3, "Structural Welding Code - Sheet Steel."

27. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

28. AWS D1.6, "Structural Welding Code - Stainless Steel."

29. AWWA D100, "Welded Steel Tanks for Water Storage."

30. DOE-G-420.1-2, "Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Non-Nuclear Facilities."

31. DOE-STD-1021-93, "Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems and Components."

32. DOE-STD-3009-94, "Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports."

33. EIA-222-F, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

34. FEMA 450, "The 2003 NEHRP Recommended Provisions for New Buildings and other Structures."

35. HNF-SD-GN-DGS-30006, "Guidelines for Assessing the Seismic Adequacy of Existing Performance Category Equipment at the Hanford Site."

36. HNF-SD-GN-ER-501, "Natural Phenomena Hazards, Hanford Site, South Central Washington."

37. HNF-SD-GN-ER-30009, "Bibliography and Summary of Geotechnical Studies at the Hanford Site."

38. HNF-SD-GN-ER-30037, "Procedure for the Prioritization of Natural Phenomena Hazard Evaluations for Westinghouse Hanford Company Facilities."

39. HNF-SD-GN-ER-30038, "Volcano Ashfall Loads for the Hanford Site."

40. ICC ER-4071, "Seismic Connection Details for Gypsum Wallboard Nonbearing Partitions and Suspended Ceilings"

41. MBMA, "Metal Building Systems Manual."

42. NFPA 22, "Standard for Water Tanks for Private Fire Protection."

43. NFPA 225, "Model Manufactured Home Installation Standard."

44. RPP-RPT-27570, "Development of PC2 Surface Spectra for Double-Shell Tank Farm Facilities, DOE Hanford Site in Washington State."

45. RPP-16643, "Seismic Requirements for Temporary Tank Farm Equipment."

46. SDI-Publ. 30, "Design Manual for Composite Decks, Form Decks and Roof Decks."

47. SDI-Publ. DDM02, "Diaphragm Design Manual."

48. SH 300, "Guidelines for Safe Practices for Erecting and Dismantling Frame Shoring."

49. TFC-ENG-STD-02, "Environmental/Seasonal Requirements for TOC Systems, Structures, and Components."

50. TFC-ENG-STD-07, "Ventilation System Design Standard."

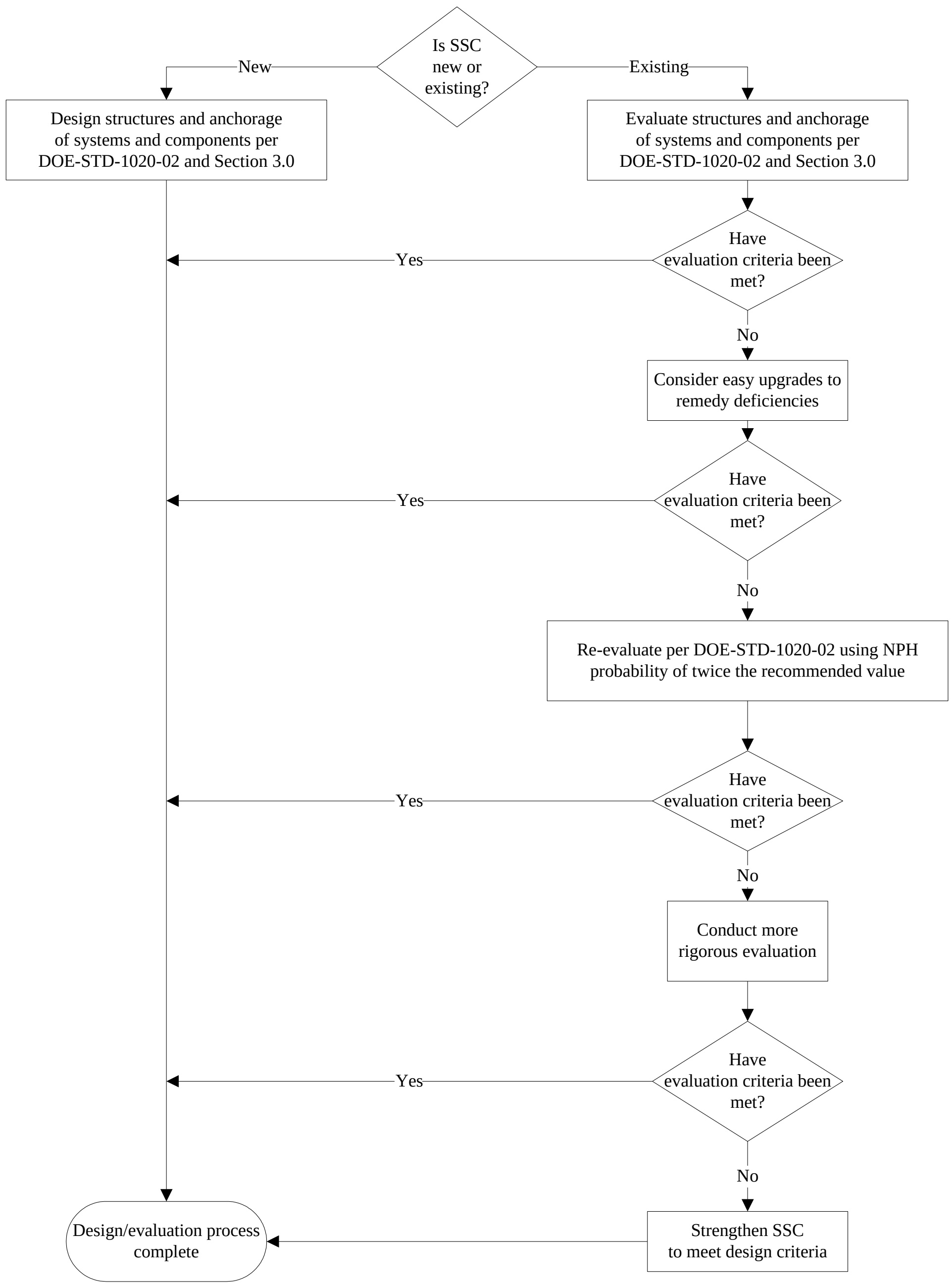
51. The Brick Industry Association, "Overview of Building Code Requirements for Masonry Structures."

52. UL 1316, "Glass Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products."

53. WAC 296-155, "Safety Standards for Construction Work," Part N – Excavation, Trenching and Shoring.

54. WAC 296-150F, 2008, "Factory-Built Housing and Commercial Structures."

Figure 1. Design Criteria Implementation.



Key:

NPH: Natural phenomenon hazards
SSC: Systems, structures, and components

Table 1. Safety Performance Category.

Facility Type	Reactor or PSO designated	Hazardous or Essential Non-Reactor Facility				General Facilities	No Safety Function
Hazard Category (2)	HC-1	HC-2		HC-3	Radiological		
Hazard Class (3)			High (HH)	Moderate (MH)	Low (LH)		
Categorizing the Hazard as depicted above does not directly influence the safety classification process nor the category							
Structures, Systems, Components, Safety Designation and Mitigating Features	Safety Class (4)		Safety Significant (4)			General Services	
	Performs or preserves reactor safety function	Prevents or mitigates rad. consequences above risk guidelines to:	Prevents or mitigates toxic chemical or on-site rad. consequences above risk guidelines to:		Worker safety. Prevents or mitigates serious injury not controlled by ISP (5) to:	Occupant and worker safety controlled by building code and ISP (5) Equipment (9)	
		Off-site public	Off-site public (toxic only)	On-site worker (rad. & toxic chemical)	Facility worker	Any occupant	No occupant
	SC-1 (6)			SC-2 (6)	SC-3 (6)	Non-Safety Class (6)	
Mission Importance	Mission Importance Criteria TBD					Not essential	None
Performance Category (1,7,8)	PC-4	PC-3	PC-2			PC-1, PC-1M	PC-0
	Goal $1x10^{-5}$	Goal $1x10^{-4}$	Goal $5x10^{-4}$			Goal $1x10^{-3}$	No Goal
Seismic Design Category	SDC-5	SDC-4	SDC-3				
Target Performance Goals	Goal $1x10^{-5}$	Goal $4x10^{-4}$	Goal $5x10^{-4}$				

NOTES:

1. DOE Program Secretarial Officer (PSO) may designate a facility to a higher Performance Category (PC).
2. Hazard category (HC) for nuclear facilities per 10 CFR 830 drives the level and rigor of DSA analysis and its references.
3. High, moderate, and low hazard class (HH, MH, and LH) for non-nuclear facilities per obsolete DOE Order 5481.1B.
4. Safety class and safety significant classification.
5. Institutional safety program (ISP) protecting against standard industrial hazards per DOE-STD-3009-94.
6. Obsolete Westinghouse Hanford Company safety class (SC). These designations no longer apply, but are still contained in existing safety equipment lists and reference documentation until they can be revised.
7. Performance goal and PC per DOE Order 420.1A.
8. Evaluate all “Design Features” on an individual basis to determine performance category.
9. Equipment used for SST retrieval/closure and facility deactivation must meet PC-1M. See Table 2 for details.

Table 2. Anchorage of Equipment.

DOE-STD-1020-02 performance category	PC-2	PC-1
Permanent Equipment	(1)	(1)
Temporary or Movable Equipment	(2)	(2)(3)(4)

1. Equipment shall be anchored to resist overturning, sliding, and possible floating. Equipment anchorage shall be designed to resist the total design lateral force without benefit from the use of friction that results from gravity loads. Friction that results from overturning forces or from clamping forces may be used. Anchorage for PC-1 and PC-2 equipment, whose failure would cause a life hazard or compromise safe access or egress from the facility, shall be designed by using the methods (and the importance factor of 1.5) in the IBC for Seismic Use Group III. The PC-1 and PC-2 floor- or roof-mounted equipment weighing less than 400 lbs is exempt from anchorage or restraint requirements. The evaluation shall be documented.

2. The PC-1 and PC-2 equipment whose failure would cause a life hazard or compromise safe access or egress from a facility shall be anchored, restrained, or shown to be stable such that the equipment item would not overturn, slide, or float. Anchorage of equipment whose failure would cause a life hazard or compromise safe access or egress shall be designed by using the methods (and the importance factor of 1.5) in the IBC for Seismic Use Group III. Items shown by analysis <u>not</u> to be vulnerable to overturning shall be restrained from sliding, unless it can be shown by analysis that the lateral movement of the item is acceptable. Items shown by analysis <u>not</u> to be vulnerable to overturning and whose lateral movement has been shown to be acceptable may be unrestrained. The maximum lateral movement should be estimated and included in the design of rattle space (space allowed for motion such as sliding) and utility connections. Floor- or roof-mounted equipment weighing less than 400 lbs, furniture, and temporary or movable PC-1 equipment whose failure does not cause a life hazard or compromise safe access or egress from a facility is exempt from anchorage or restraint requirements. The evaluation shall be documented.

3. Equipment used for SST retrieval/closure and for facility deactivation must meet PC-1M requirements. PC-1M provides the same loading requirements as PC-1 except that seismic loading is not required. PC-1M equipment is not subject to sliding when placed unrestrained on the ground surface in tank farms. Generally, overturning will occur if the ratio of the vertical distance to the equipment center of gravity to the shortest horizontal distance from an edge of the equipment to its center of gravity is greater than 2.8. For further information, consult RPP-16643, "Seismic Requirements for Temporary Tank Farm Equipment." If this ratio is exceeded, restraints would be needed, but wind loading will probably govern in this instance. Equipment that will contain waste needs to be evaluated also against project-specific safety or hazard analyses. Equipment installed on skids (such as pumps, tanks, junction boxes) must meet manufacturer's requirements for attaching to the skid.

4. PC-1 equipment that does not pose a threat to life safety is exempt from anchorage or restraint requirements. However, the expense or procurement time to replace unanchored equipment that may be damaged should be considered in the decision to have the equipment unanchored.

Table 3. Wind Load

	PC-2	PC-1
"Three-Second Gust" Wind Velocity V	91 mi/h[(b)]	85 mi/h
Importance Factor I	1.0[(b)]	1.0
Exposure Category	C[(a)]	C[(a)]
Missile (horizontal)	na	na

(a) Exposure "C", flat and generally open terrain, should be used for all construction unless it can be shown that the necessary permanent shielding will be provided by natural terrain (not including shielding from trees or adjacent buildings).

(b) DOE-STD-1020-02 requires the use of an importance factor of 1.0 with a wind velocity of 91 mph. This has the same effect of using the IBC code wind velocity of 85 mph with the IBC importance factor of 1.15 when used in the formula for calculating wind pressure.